

## Science Examples Webb's Depth of Knowledge

### Sample Science Assessment Items

Now try coding some sample assessment items using the science DOK levels. There are six items for grade 8 and six for high school. After you are finished coding these, read our “answers” on the following page.

### Grade 8

1)

Which group of organisms would all be found living in a tropical rain forest?

- A) Lizards, insects, cacti, kangaroos
- B) Vines, palm trees, tree frogs, monkeys
- C) Evergreens, moose, weasels, mink
- D) Lichens, mosses, caribou, polar bears

2) Make a graph of your heart rate as you walk in place for five minutes.

3)<sup>1</sup>

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The purpose of this task is to determine where, how high, and for what purpose (flood control, recreation, hydroelectric power, etc.) to build a dam. You will have a total of 45 minutes to complete this task. You may use up to 20 minutes to complete the group work, found on the first two pages of this form. When you finish the group activity, someone from your group should tell the facilitator. Then you may open this form and follow the directions inside by yourself.

Your group should have the following materials:

- Plastic model
- Clay
- Water in a pitcher
- Map
- Ruler
- Paper towels

Pencils (cont'd on next page)

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<sup>1</sup> [This item was contributed to the PALS (Performance Assessment Links in Science) website (<http://www.ctl.sri.com/pals/>) by the Kentucky Department of Education.]

## GROUP ACTIVITY (cont'd from previous page)

1. Examine the model of the river valley as well as the map you have been provided. Using this information, discuss possible sites for a dam.
2. Use the clay to construct a dam on the model. With the water, test the impact of your dam on the nearby areas. Try different locations and dam heights based upon the dam's purpose. Record the different locations on the group's map. Record information from the trials in the chart on the next page.

Record information from your group's tests in this chart.

Site #	Location	Purpose	Impact

Make sure that each group member's name appears on the map. One member of the group should insert the map into his or her response form when passing in the completed form.

When you are finished with the work on this page, one member of the group should tell the facilitator that your group has finished its group work. Then go on to the individual work. Remember that you must work alone on those pages. You may not discuss the questions or share information.

## INDIVIDUAL ACTIVITY

3. After reviewing the work your group has done, where would you place the dam and how high would you make it? Why?
4. What social, environmental, and economic impacts would the location you chose for the dam have on the surrounding community?
5. Describe concerns you would include in an environmental impact statement for dam sites other than the one you selected in question 3.

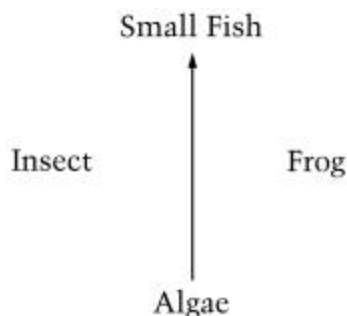
Be sure one member of the group inserts the map inside his or her form for collection.

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4) When operating, ordinary incandescent lightbulbs produce a lot of heat in addition to light. Fluorescent lightbulbs produce much less heat when operating. If you wanted to conserve electricity, which type of bulb should you use? Explain your answer.

5)

You will now finish a diagram of a food web in the pond. The food web shows what eats what in the pond system. Draw arrows in the diagram below from each living thing to the things that eat it. (The first arrow is drawn for you.)



6)

Suppose that a farmer near the pond sprayed crops with a pesticide to kill insects and that some of the spray washed into the pond. (This pesticide breaks down very slowly.) If several months later a biologist tested all the organisms in the pond system for the pesticide, which organism would most likely have the greatest concentration of the pesticide? Explain your answer.

[The following six items are from High School assessments. The first two items refer to the passage immediately below.]

During the development of chemistry, many chemists attempted to explain the changes that occur when *combustible* (capable of burning) materials burn and metals corrode or rust. The following are two proposed theories.

#### *Phlogiston Theory*

According to this theory, combustible materials, such as wood, coal, or metal contain a massless "essence" or presence called phlogiston. When combustion occurs, the phlogiston is released from the combusting object and is absorbed by the air. For example, when a piece of wood is burned, phlogiston is released to the air and the wood is converted to ash. The ash is free of phlogiston and can no longer support combustion. Similarly, if a metal is

heated, the phlogiston is lost to the air and the metal is converted into a nonmetallic, powdery substance called ash, or calx. The *corrosion* (changing of a substance by a chemical reaction) of metals, such as the rusting of iron (Fe), also involves the loss of phlogiston from the metal, but at a slower rate than burning. Rust can be turned back into metal by heating it in air with a substance rich in phlogiston, such as charcoal. A transfer of phlogiston from the charcoal to the rust converts the rust back to metal.

### *Oxygen Theory*

According to this theory, burning and rusting involve an element called oxygen, which is found in the air. The complete combustion of a piece of wood involves the rapid reaction of the wood with oxygen gas ( $O_2$ ) to produce carbon dioxide ( $CO_2$ ), which is a nonflammable gas, and water ( $H_2O$ ). The rusting of iron involves the slow reaction of iron with oxygen to produce iron oxides such as  $Fe_2O_3$ . These iron oxides are known as rust. Heating rust with charcoal produces iron because the charcoal combines with the oxygen in the rust. In these transformations, there is a *conservation of mass* (the total mass of the reactants must equal the total mass of the products in a chemical reaction). In these reactions matter is neither created nor destroyed, but merely transformed.

7) According to the Phlogiston Theory, the gases collected from the complete burning of a piece of charcoal in air would be capable of:

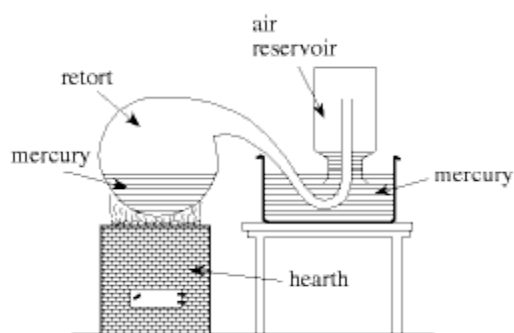
F. converting the ash from corroded tin back to tin metal.

G. supporting combustion of another piece of charcoal.

H. rusting iron.

J. converting wood ash into rust.

- 8) A chemist heated a sample of mercury for several days in the apparatus shown below. As the experiment proceeded, the mercury in the retort became covered with a red powder, and the volume of mercury increased in the air reservoir. The remaining material in the reservoir would not support combustion. Which of the following theories is supported by the results of this experiment?



- A. The Phlogiston Theory, because the red powder resembled an ash
- B. The Phlogiston Theory, because the air in the reservoir could not support combustion and therefore did not contain oxygen
- C. The Oxygen Theory, because the mercury level dropped in the air reservoir indicating increased oxygen content
- D. The Oxygen Theory, because the mercury level rose in the air reservoir indicating decreased oxygen content

### **High School**

- 9) A scientist synthesizes a new drug. She wants to test its effectiveness in stopping the growth of cancerous tumors. She decides to conduct a series of experiments on laboratory mice to test her hypothesis.

What should she do?

- a. Give half the mice the drug, the other half none, and compare their tumor rates.
- b. Give the drug to all mice, but only to half every other day, and record tumor rates.
- c. Double the dosage to all mice each day until tumors start to disappear.
- d. Give the drug only to those mice who have tumors and record their weights.

10) The results of one of her experiments are shown in the table below:

Average tumor size in millimeters by dosage and days of treatment

Dosage	Days of Treatment						
	1	7	14	21	28	35	42
150mg	5	6	8	11	13	15	18
300mg	5	5	6	7	7	9	10
600mg	5	5	4	4	5	4	3

What can she conclude from these results?

- The effectiveness of the drug over time depends on the size of the dosage.
- The drug is effective over time regardless of the size of the dosage.
- The size of the dosage affects tumor size regardless of the length of time.
- The drug is ineffective regardless of the dosage or length of time.

11) What is the process called which plants use to manufacture sugar from sunlight?

12) In a laboratory experiment using spectrophotometry, an enzyme is combined with its substrate at time zero. The absorbance of the resulting solution is measured at five-minute intervals. In this procedure, an increase in absorbance is related to the amount of product formed during the reaction. The experiment is conducted using three preparations as shown in the table below.

Enzyme preparation	Absorbance				
	0 min	5 min	10 min	15 min	20 min
I. 3 mL enzyme, 2 mL substrate, pH 5	0.0	0.22	0.33	0.38	0.37
II. 3 mL boiled enzyme, 2 mL substrate, pH 5	0.0	0.06	0.04	0.03	0.04
III. 3 mL enzyme, 2 mL substrate, pH 6	0.0	0.32	0.37	0.36	0.38

The most likely reason for the failure of the absorbance to increase significantly after 10 minutes in preparation III is that

- the reaction is thermodynamically impossible at pH 6
- the enzyme is not active at this pH
- a pH of 6 prevents color development beyond an absorbance of 0.38
- the enzyme is degraded more rapidly at pH 6 than it is at pH 5
- most of the substrate was digested during the first 10 minutes